



IRP Workshop on Production Cost Modeling, Aggregated LSE Portfolios, and Portfolios for the CAISO Transmission Planning Process



October 31st, 2018

California Public Utilities Commission

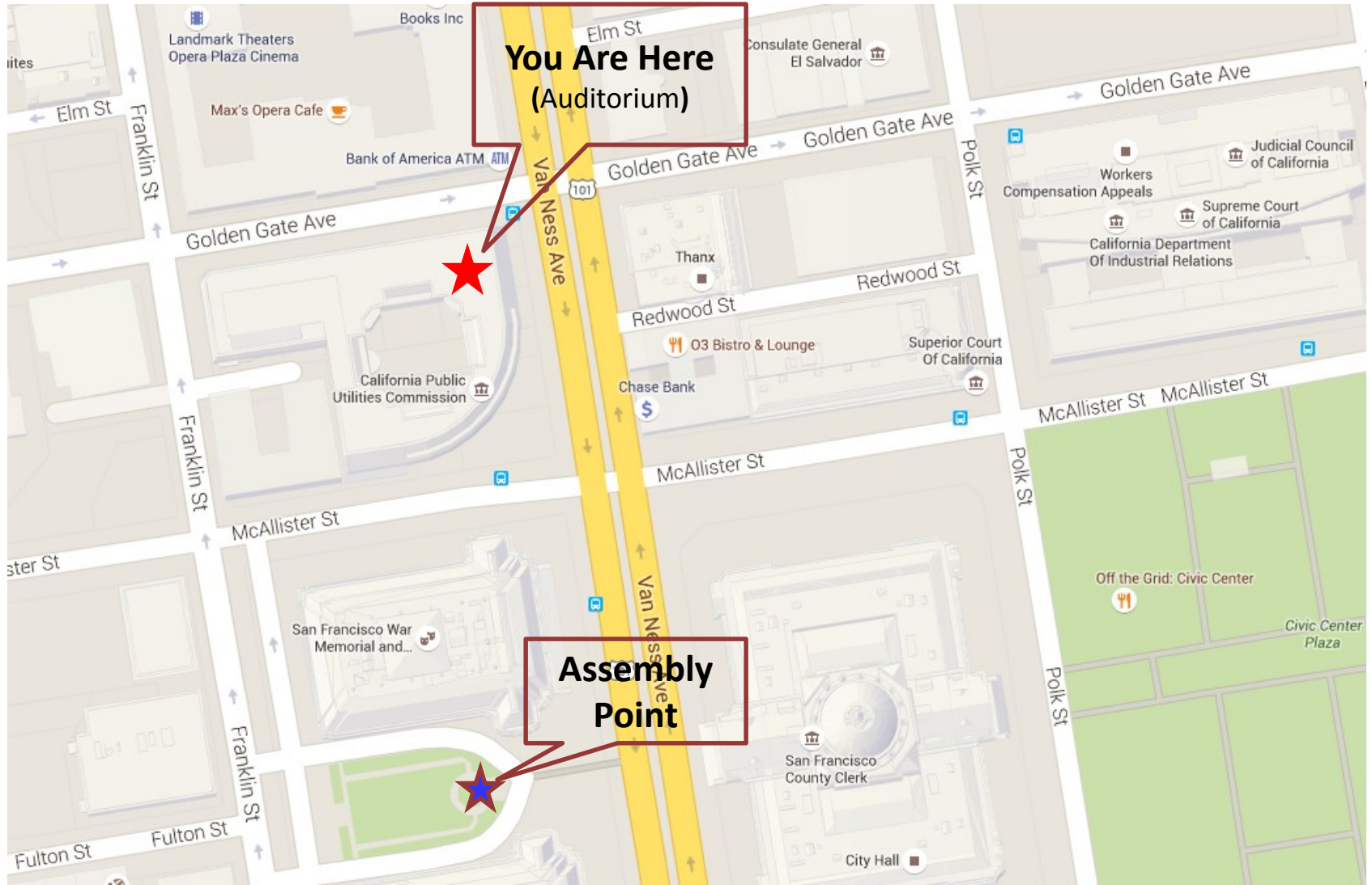
Introduction

- Housekeeping
 - Staff introductions
 - Informal workshop, not on the record
 - Safety information and logistics
- Workshop purpose and agenda

Safety and Emergency Information

- In the event of an emergency, please proceed out the exits.
- We have four exits: Two in the rear and one on either side of the speakers.
- In the event that we do need to evacuate the building:
 - Our assembly point is the Memorial Court just north of the Opera House.
 - **For the Rear Exits:** Head out through the courtyard and turn right to exit on Golden Gate Avenue. Proceed west to Franklin Street. Continue south on Van Ness Ave, and continue toward the Memorial Court.
 - **For the Side Exits:** Go out of the exits and you will be on Golden Gate Avenue. Proceed west to Franklin Street. Turn south onto Franklin Street, and continue toward the Memorial Court.

Evacuation Map



Call-in Information

To start or join the online meeting, go to:

<https://centurylinkconferencing.webex.com/centurylinkconferencing/j.php?MTID=m266f184570af12ca03d9a613dd674328>

Meeting number: 712 952 428

Meeting password: !Energy1

Call-in: 1-866-830-2902

Passcode: 2453758#

- Remote callers will be placed in listen-only mode by default. Please submit questions via the WebEx chat.
- We will have time for Q&A at the end of each panel.
- Please state your name and organization before speaking.

Other Information

Wi-Fi Access

- login: guest
- password: cpuc92818

IRP Websites

- Main webpage for IRP materials
 - <http://www.cpuc.ca.gov/irp/>
- Shortcut to production cost modeling related data
 - [Production Cost Modeling Data](#)
- All staff work products are available for download

Restrooms

Out the Auditorium doors and down the far end of the hallway.

Purpose of Workshop

- Workshop purpose:
 - Discuss party comments on production cost modeling and staff recommendations to revise process
 - Explain how staff aggregated and analyzed LSE plans, and present initial results
 - Describe the portfolios of resources that staff proposes:
 - To serve as the Preferred System Portfolio for IRP
 - To transmit to CAISO for its Transmission Planning Process (TPP)
 - Solicit informal party feedback on staff conclusions and recommendations based on the analysis
- Out of scope:
 - Staff's evaluation of individual LSE Plans

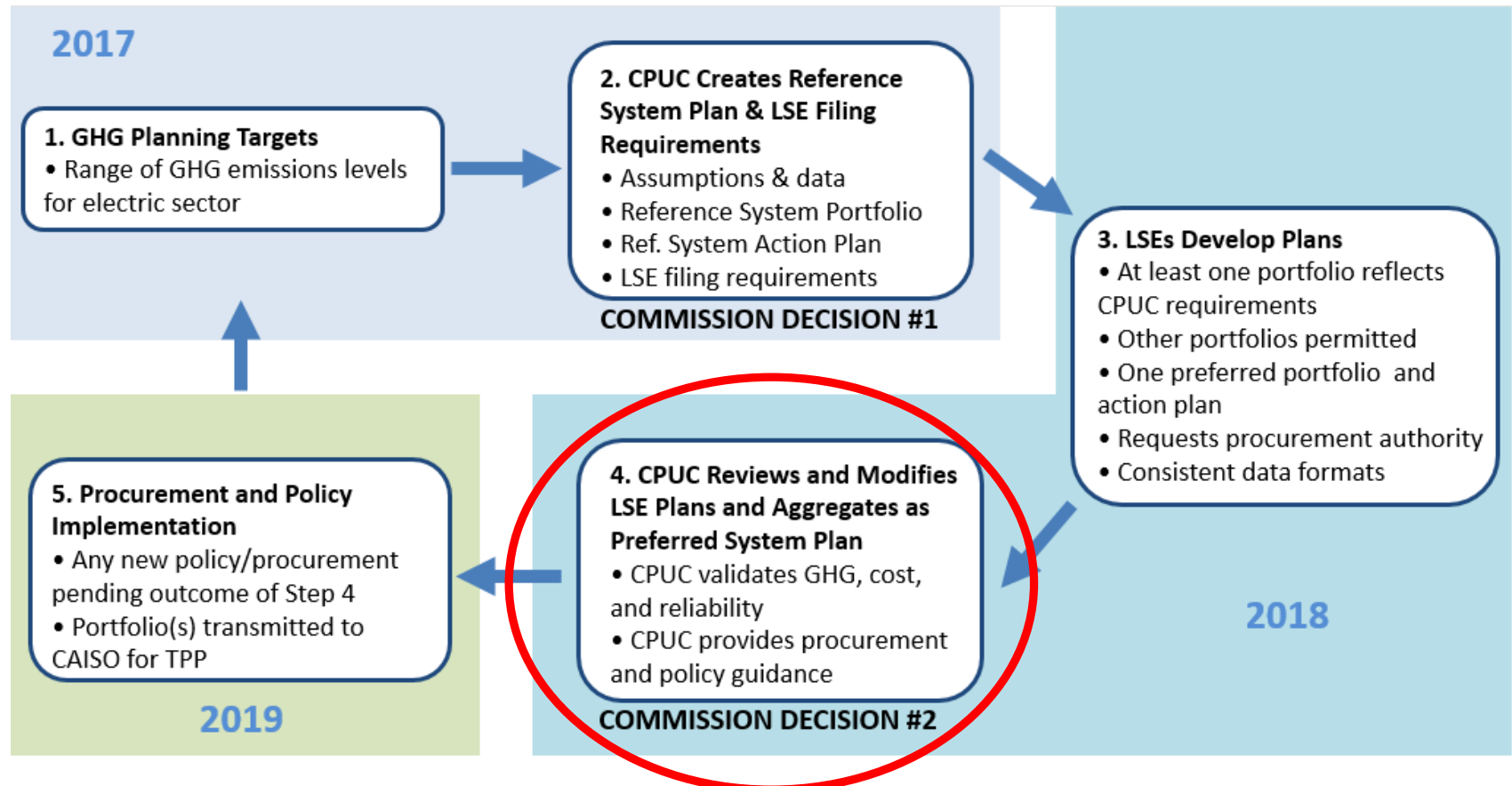
Agenda

I.	Introduction	10:00 – 10:15
II.	Revised PCM Approach	10:15 – 11:30
	STRETCH BREAK	11:30 – 11:35
III.	Results of LSE Portfolio Aggregation (1 of 2)	11:35 – 12:30
	LUNCH	12:30 – 1:30
IV.	Results of LSE Portfolio Aggregation (2 of 2)	1:30 – 2:30
	STRETCH BREAK	2:30 – 2:35
V.	Portfolios for the Preferred System Plan and CAISO TPP	2:35 – 3:30
VI.	Q&A with Audience	3:30 – 4:00

Background

- Commission Decision (D.18-02-018) established IRP as a two-year planning cycle designed to ensure LSEs are on track to achieve GHG reductions and ensure grid reliability while meeting the state's other policy goals in a cost-effective manner
- In Feb. 2018, the Commission adopted the Reference System Plan projecting achievement of a 42 MMT GHG emissions target for the state's electric sector
- LSEs filed their individual IRPs ("LSE Plans") with the Commission on August 1st, 2018; CPUC staff is currently reviewing LSE Plans to verify consistency with the Commission's guidance
- In parallel with LSE IRP development, CPUC staff has prepared the Strategic Energy Risk Valuation Model (SERVM) to conduct production cost modeling on the aggregated LSE portfolios to evaluate system reliability, emissions, and operational performance
- The Commission expects to adopt a Preferred System Plan in Q1 2019

Currently in Step 4 of the IRP 2017-18 Process



Staff is evaluating the LSE Plans, has aggregated the LSE portfolios, and is ready to begin production cost modeling to inform the Preferred System Plan

LSE Plans Filed

- 43 LSEs made an IRP filing on Aug. 1, 2018
 - 3 IOUs
 - 20 CCAs
 - 13 ESPs
 - 3 small and multi-jurisdictional utilities
 - 4 electric cooperatives (demonstrated exemption from IRP process)
- One LSE Plan still outstanding: Commercial Energy of CA (ESP)
- Of the 39 LSE Plans filed...
 - 26 are “Standard LSE Plans” from larger LSEs (> 700 GWh annual load)
 - Requires more detailed showing and provision of contract data for IRP modeling purposes
 - 13 are “Alternative LSE Plans” from smaller LSEs

LSE Plan Review Process

- Staff has divided the LSE Plan review process into two parallel tracks:
 - Review of narrative LSE Plans to assess whether each section meets requirements of D.18-02-018, including meeting the 2030 GHG benchmark, minimizing local air pollutants, etc. (IRP staff)
 - Review of LSE data submissions for aggregation, preparation for production cost modeling, and development of Preferred System Plan (Modeling staff)
- **Phase 1:** Verify that correct filings were made (Early Aug.)
 - Four LSEs asked to provide missing information
- **Phase 2:** Verify consistency with Commission direction (Aug.–Oct.)
 - 23 LSEs asked to make corrections/clarifications to data filings
- **Phase 3:** Development of Preferred System Plan (underway)
 - Recommended Commission action will depend on outcome of IRP modeling and any deficiencies identified in individual LSE Plans

Schedule of Activities Leading to IRP 2018 Preferred System Plan

Activity	Date
Workshop on aggregated LSE portfolios and proposed reliability base case	Oct. 31, 2018
Ruling on production cost modeling guidelines and aggregated LSE portfolio dataset	Early Nov. 2018
Modeling Advisory Group Office Hours <ul style="list-style-type: none"> • Short webinars for staff to answer stakeholder questions on how to model the Conforming Hybrid Portfolio 	Tentatively Nov. 13 and Nov. 20, 2018
Modeling parties informally submit results to staff in preparation for workshop <ul style="list-style-type: none"> • Alternatively modeling results can be subsequently submitted as formal comments to allow more time to complete analysis 	Week of Dec. 3, 2018
Workshop where staff and modeling parties present their production cost modeling and other analytical results	Week of Dec. 10, 2018
Ruling Seeking Comment on Proposed Preferred System Plan: <ul style="list-style-type: none"> • Production cost modeling results and analysis • Portfolios for CAISO Transmission Planning Process 	Dec. 2018
Comments and Replies to Ruling on Proposed Preferred System Plan	Jan. 2019
Proposed Decision on Preferred System Plan	Q1 2019



Party Comments on Production Cost Modeling (PCM) Approach



October 31st, 2018
California Public Utilities Commission

Background

- On Sept. 24, 2018, the CPUC issued a ruling seeking comment on production cost modeling (PCM) in the IRP proceeding
 - Revised PCM guidelines for system modeling to inform the IRP process
 - Results from staff PCM studies of the Reference System Plan, calibrated with the 2017 IEPR
- Parties filed comments (10/10) and replies (10/17)
 - Inputs and methods generally
 - Loss Of Load Expectation (LOLE) and Effective Load Carrying Capability (ELCC) issues specifically
 - Outputs
 - Process
- Staff proposes some adjustments to the modeling framework, prioritizing items to be implemented now and items to be implemented in the 2019-20 IRP Reference System Plan development process
 - Adjustments prioritized now are focused on getting portfolios to the upcoming CAISO Transmission Planning Process (TPP)
- Staff intends to more tightly coordinate RESOLVE and SERVM modeling in the next IRP as explained on the next two slides

Role of PCM in IRP

Reliability is critical to the IRP, alongside GHG and cost metrics. CPUC staff perform system reliability analysis on the Reference System Plan (RSP) and the Preferred System Plan (PSP) in two main ways:

- Benchmark with the reserve margin reported in RESOLVE
- Verify with full PCM and LOLE evaluation using the SERVVM model

CPUC staff produced the RSP with coarse reliability analysis and limited calibration between RESOLVE and SERVVM after the fact

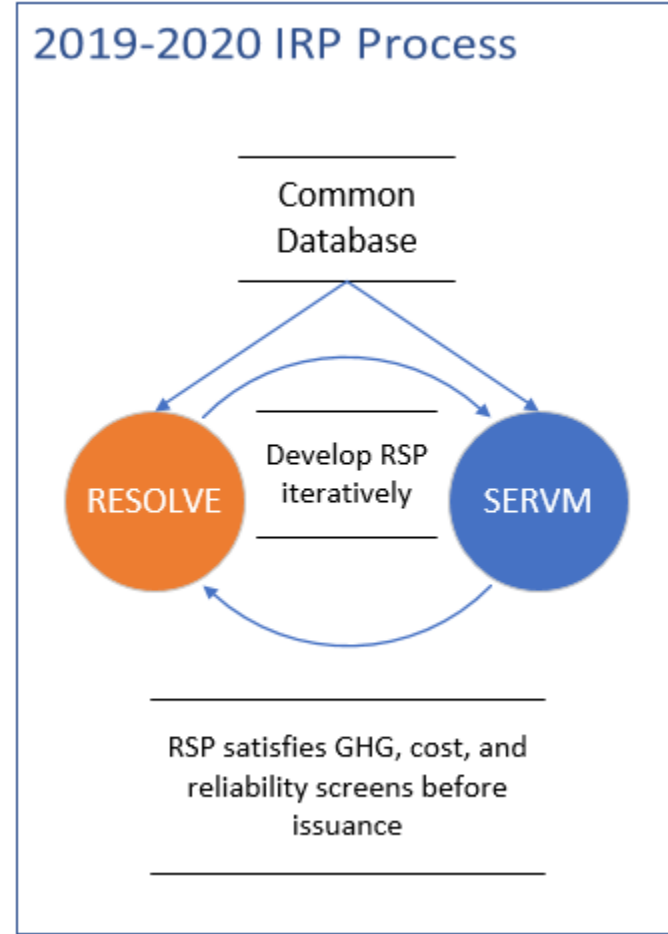
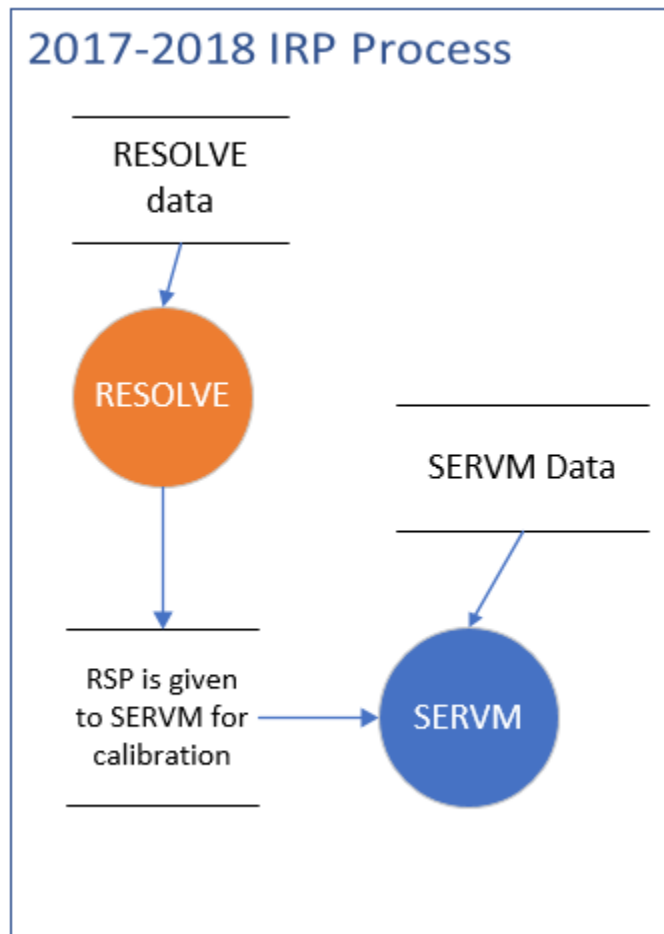
- Coarse Local and Flexible reliability analysis
- Data development was uncoordinated; there were differences in model function

Staff plans to develop the RSP in parallel in the next IRP cycle

- 2017-2018 IRP cycle, RESOLVE and SERVVM modeling were in serial
 - Data development was not coordinated and PCM was done after RSP adoption
- 2019-2020 IRP cycle, RESOLVE and SERVVM in parallel
 - Data development will be coordinated and PCM will be performed as RSP is being developed for adoption. Improve consideration of Local RA requirements.

Development of Reference System Plan (RSP)

2017-2018 IRP versus 2019-2020 IRP – from serial to parallel



Party comments: Inputs and methods (1)

- Many parties argued that the inputs and methods of the RESOLVE and SERVVM models are not sufficiently aligned for comparison
 - SERVVM estimates emissions will be higher than the 42 MMT target. How will the Commission reconcile the difference between models and ensure the 42 MMT target is met?
 - SERVVM estimates much higher levels of curtailment than RESOLVE and requires deeper investigation to understand drivers
 - Generation from BTM PV and utility-scale renewables need further reconciliation with RESOLVE
 - BTM PV energy generation in SERVVM modeling exceeded IEPR forecast
 - Differences in assumed OOS renewables delivering to CAISO (or not)

Party comments: Inputs and methods (2)

- Many parties questioned the assumption that thermal plants would remain online through 2030 and suggested:
 - Studying economic retirement, or at a minimum use a 40 year age threshold assumption
 - Assessing how much capacity must stay online to just meet the desired reliability target
- Several parties asked for more clarity and granularity on the SERVIM modeling of air pollutants, especially with regards to effects on disadvantaged communities
- Other corrections proposed by various parties:
 - Use more granular import emissions factors to reflect cleaner NW imports rather than assuming a fixed NW hydro credit in emissions accounting
 - Update operating reserves modeling to conform to new NERC/WECC BAL-002 standard
 - Net export limit in 2030 should be lowered from 5000 MW to 2000 MW
 - Storage dispatch modeling in both models need to be better understood and account for differing use cases

Staff proposal: Inputs and methods

- Prioritize changes that are feasible to complete and still provide the required portfolios for the 2019-2020 TPP on time
- Intended changes prior to modeling to inform the Preferred System Plan
 1. Retire thermal units older than 40 years (and if the unit still has a contract then its life extends to the end of the contract; and if the unit is cogeneration with a thermal host, assume it does not retire)
 2. Scale down BTM PV energy production to match RESOLVE and the 2017 IEPR
 3. Where feasible, use the more granular air pollutant emission factors proposed by several parties, in order to improve NOx emissions estimates
 4. Correctly model OOS renewables as delivering to CAISO or not
 5. Incorporate the new resources from the aggregated LSE plans – subject to alignment with physical constraints that were assumed in the RESOLVE model
 6. Decrement the baseline of 1,325 MW by 2024 represented by the CPUC storage target for IOUs so as to NOT double count the new build storage reported by IOUs in their new resource conforming plans
- Changes to be considered at the start of the next IRP cycle
 1. Improve representation of lower emissions from NW imports in lieu of the fixed NW hydro credit
 2. Incorporate new NERC/WECC BAL-002 standard into modeling of operating reserves
 3. Revisit the net export limit assumption in Reference System Plan development

Staff proposal: Addressing the 42 MMT GHG target

- The Commission adopted an electric sector GHG planning target of 42 MMT in 2030 for IRP, based on the RESOLVE model
- Subsequent SERVVM modeling estimated emissions will be 2-3 MMT higher
- Several changes to SERVVM inputs will be implemented prior to modeling the aggregated LSE plans, which could change the emissions result
- Staff recommends proceeding with modeling to determine what emissions would result from the proposed input changes and the incorporation of the aggregated LSE plans
- Deeper investigation of alignment between the RESOLVE and SERVVM models will be pursued as part of the next IRP cycle's Reference System Plan development process
 - Inputs to both models will be sourced from common sources to the extent possible and developed together
 - Curtailment and storage dispatch differences will be thoroughly investigated
 - Goal is consistent estimate of GHG emission between the two models
- After sufficient convergence in outputs between models, the GHG target can be revised as needed to ensure achievement of policy objectives

Party comments: LOLE and ELCC issues

- Several parties expressed concerns with the ELCC calculation framework and the associated LOLE reliability target
 - Concern that monthly studies increase the industry standard 0.1 LOLE on an annual basis to the equivalent of 0.3 LOLE
 - Suggest moving to annual studies only, using 0.1 LOLE target
- Several parties highlighted the importance of a consistent ELCC framework across multiple proceedings (e.g. RA, IRP, RPS, storage procurement), but differed in recommended implementation
 - Average vs. marginal ELCC values
 - BTM PV should have its own ELCC vs. be treated as a load-modifier
 - ELCC issues should be litigated in the RA proceeding

Staff proposal: LOLE and ELCC modeling changes

- Staff proposes to make the following changes to the PCM process used to evaluate the aggregation of LSE plans and inform the Preferred System Plan:
 - Conduct annual LOLE studies to determine if at least 0.1 LOLE reliability is achieved, for study year 2030 only (i.e. the “as found” type of studies that were done on the Reference System Plan)
 - No ELCC studies will be performed
 - Staff expects the annual LOLE studies to show the system is more reliable than 0.1 LOLE. Staff will further assess reserve margin by removing effective capacity until the 0.1 LOLE target is reached. The amount of removed effective capacity will be reported as an indication of reserve margin.

Party comments: Outputs

- Several parties requested additional outputs from the PCM process
 - Report air pollutant emissions for individual and aggregate of plants located in Disadvantaged Communities
 - Report WECC-wide GHG emissions
 - Report hourly average system emissions rates and marginal ELCC values by resource type to inform LSE plan development

Staff proposal: Outputs

- Prior to modeling to inform the Preferred System Plan
 - Develop post-processing to report aggregate air pollutant emissions in Disadvantaged Communities
 - Investigate feasibility of reporting by specific unit and any confidentiality concerns
- To be considered with Reference System Plan development in the next IRP cycle
 - Consider sensitivities on NW hydro delivering to CAISO or the NW
 - Consider additional analytical work and value of reporting hourly average system emissions rates and marginal ELCC values by resource type

Party comments: Process

- Several parties pointed out a need for more robust stakeholder engagement to provide feedback on IRP modeling and for stakeholders to put forth their own analysis for Commission consideration
- Several parties requested more detail on how the aggregated LSE plan will be compiled and how any contradictions (e.g. internal or with RESOLVE constraints) will be reconciled
- The CAISO highlighted the importance of timely delivery of a reliability and policy-preferred base case for the start of the 2019-20 Transmission Planning Process (TPP) (by Feb. 2019)

Staff proposal: Process

- The calendar presented earlier charts the stakeholder process remaining for this 2017-18 IRP cycle – an ALJ ruling following this workshop is expected to formalize this schedule and lock down portfolios to model
 - Staff is working with the CAISO to develop a workable plan for transmitting the TPP portfolios on time
- Methods and results for aggregating the LSE plan data are presented later in this presentation



Results of Load Serving Entity (LSE) Conforming Portfolio Aggregation



October 31st, 2018

California Public Utilities Commission

Purpose and Analytic Questions

Purpose of presentation

- Explain how staff aggregated and analyzed LSE plans, and present initial results.
- Solicit feedback on staff conclusions and recommendations based on the analysis.

Analytic questions

- Which portfolios should staff analyze in aggregate – conforming or preferred portfolios?
- How do aggregate LSE resources compare to forecast load?
 - Have LSEs proposed reasonably sufficient resources?
- How do aggregate LSE resources compare to resources in the Reference System Plan based on 2017 IEPR?
 - Are differences substantive?

Definitions

- **Planned purchases:** proposed energy or capacity purchases that the LSEs submitted in their data templates
 - Note: these planned purchases do not imply RA compliance positions and do not include the assumed short-term market purchases that LSEs will make to serve load.
- LSEs submitted two different data templates: **baseline** and **new**.
 - **Baseline** planned purchases of energy or capacity are from resources that exist or are already planned to be built as of 2018.
 - **New** planned purchases of energy or capacity are from resources that do not exist and are not yet planned as of 2018, but could be built. These are comparable to the resources “selected” by RESOLVE in the Reference System Plan (RSP).
- **Integrated Energy Policy Report (IEPR) load:** represents forecasted annual energy sales from CPUC-jurisdictional LSEs within CAISO
- These terms will be used throughout this presentation

Analytic Approach

- Summarize planned energy and capacity purchases in aggregated conforming LSE plans
- Compare LSEs' planned baseline resources to existing capacity on the CAISO system
- Compare LSEs' planned new resources to the new resources selected by RESOLVE in the Reference System Plan based on the 2017 IEPR
- Verify new resource purchase proposals do not exceed system potential or transmission capability

Analytic Approach (continued)

- Aggregate all LSE plans into single dataset
- Standardize resource types and regions to allow for aggregation and ensure that planned purchases of capacity do not exceed physical limits of system
- Data cleaning – identify and correct anomalous values, units called by multiple names, incorrectly entered resource types or regions.
 - Contact LSEs to answer clarifying questions and correct and re-submit data where necessary
- Compare new resources in the aggregated LSE plans with those that RESOLVE selected based on the 2017 IEPR forecast and are currently in the SERVVM dataset

Use of Conforming Portfolios

- Staff aggregated LSE plans using only conforming portfolios and not preferred portfolios.
- LSEs' conforming and preferred portfolios differed primarily in their assumptions about which policy futures will materialize
 - SCE's and PG&E's preferred plans assumed approval of their PCIA proposal, which did not occur
 - SCE's preferred plan targeted 30 MMT by 2030
- Other differences between conforming and preferred portfolios did not impact system-level resources enough to justify modeling preferred portfolios in aggregate.
- All analysis in subsequent slides reflects characteristics of the aggregate conforming portfolios.

Notes on “Alternative LSE Plan” Filers

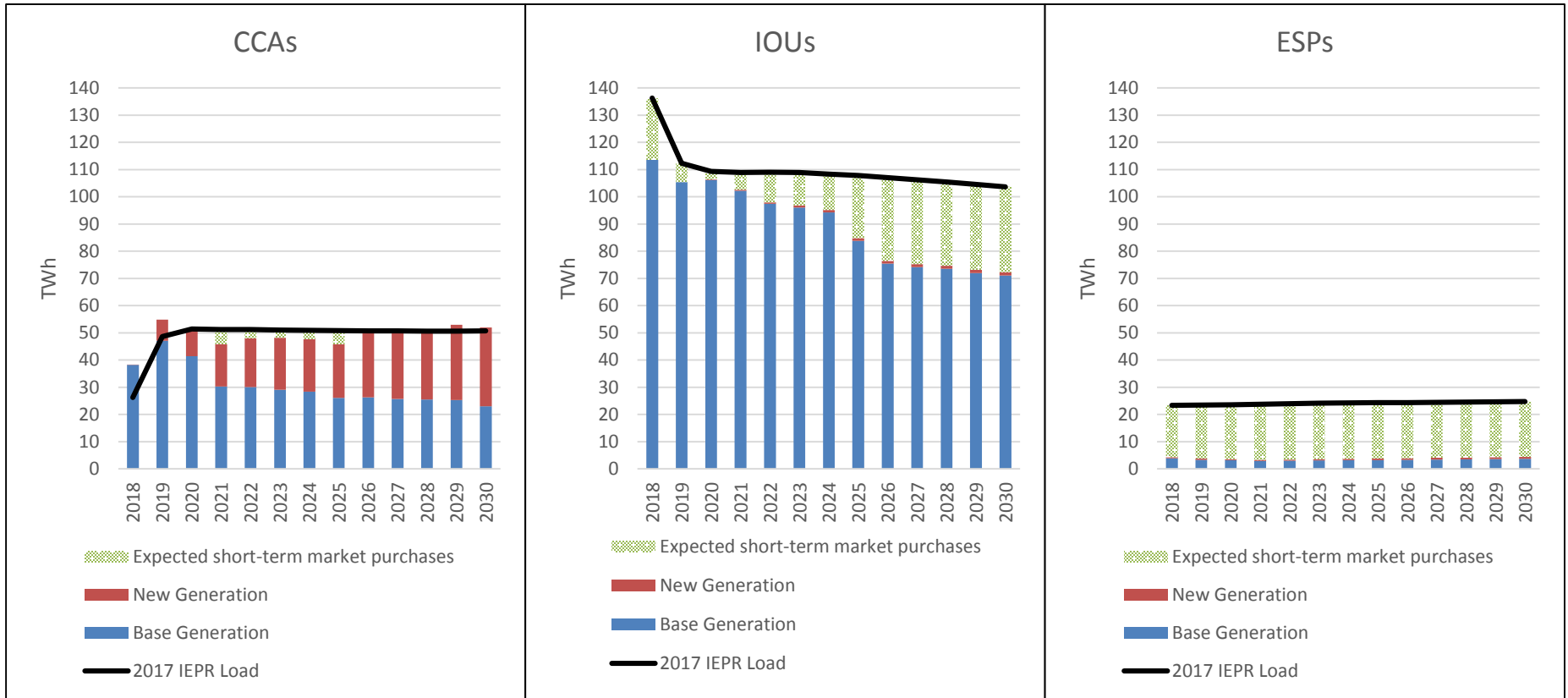
- Charts presented in this deck represent all the Standard filers, roughly 97% of LSE load.
- The residual 3% of 2030 load is served by Alternative LSE Plan filers (who generally filed S-1 and S-2 forms in lieu of using the data template)
 - LSEs eligible to file an Alternative LSE Plan include those with a projected load of less than 700 GWh/year in each of the first five years of the IRP planning horizon

Load estimate from LSEs filing nonstandard plans versus total system load

LSE Type	2030 load subtotal from Alt. LSE Plan filers, 2017 IEPR TWh	2030 load total for all LSEs, 2017 IEPR TWh	Percent of load served by Alt. LSE Plan filers
Co-ops	0.5	N/A	N/A
IOUs	1.6	103.7	2%
ESPs	2.0	24.7	8%
CCAs	0.7	50.7	1%
Total	4.77	179.01	3%

- Data from the Alternative LSE Plan filers is not included in the following results.

Total planned baseline and new energy purchases, TWh, by LSE type

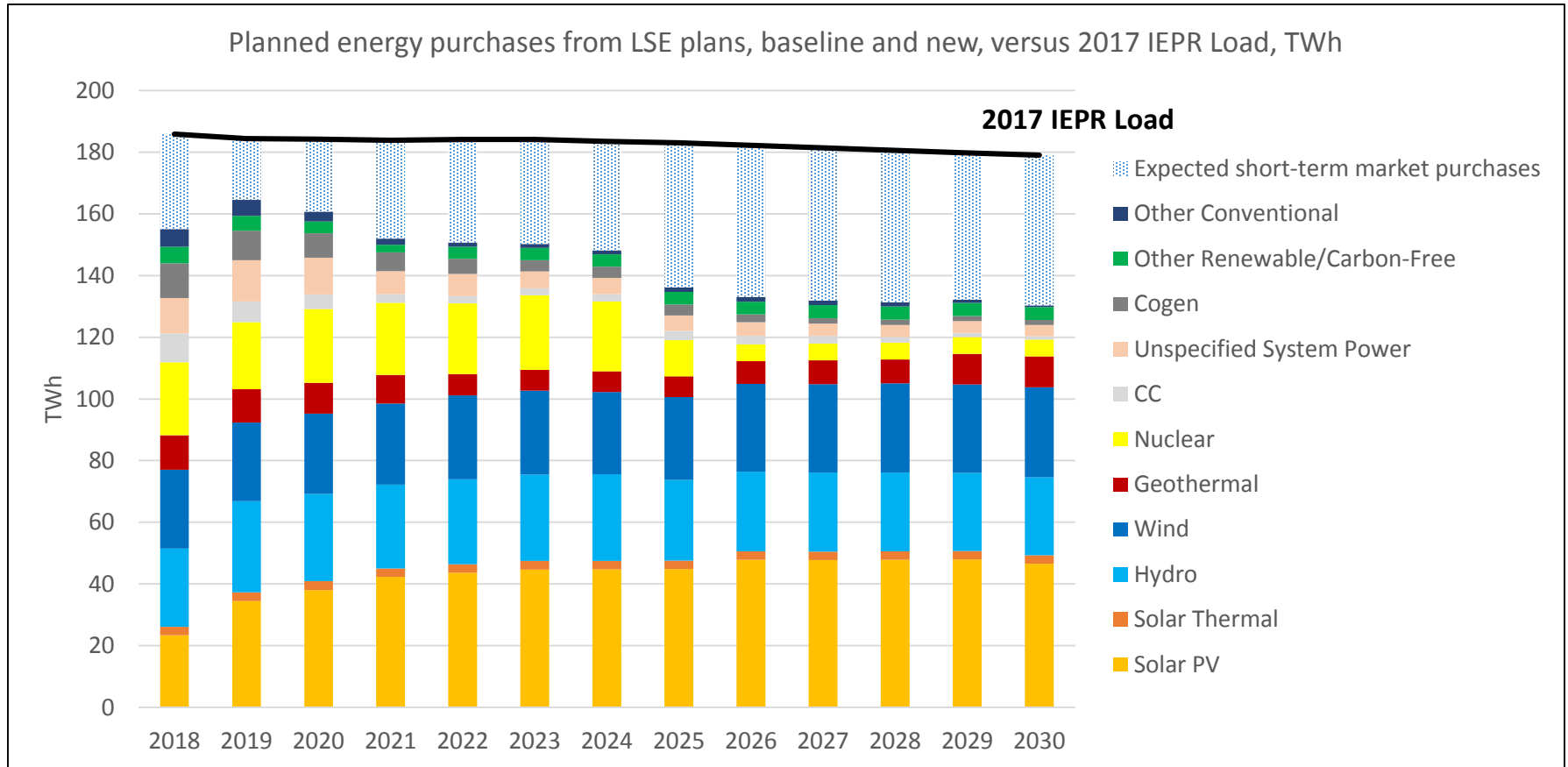


LSEs commit to different levels of energy purchases over time

- IOU procurement intentionally meets a declining portion of total load over time to minimize risk
 - This may reflect declining load share and hedging practices in the IOUs' bundled procurement plans
- CCAs plan to purchase the majority of new resources and provide portfolios where resources match load through 2030
- ESPs typically purchase resources on a much shorter time frame than the IRP planning horizon

The faded green area indicates the gap between planned energy purchases from LSE plans and IEPR load. The gap is expected to be filled with short-term market purchases and does not imply any procurement or RA deficiencies.

Total planned baseline and new energy purchases, TWh, by resource type



NOTES

- Wind, Hydro, Geothermal, Nuclear, and Solar form the bulk of planned energy purchases
- Nuclear drops off in 2026 due to the retirement of Diablo Canyon
- Energy contracts for Cogeneration (Cogen) and Combined Cycles (CC) decrease over time
- Many LSEs have indicated purchases of unspecified system power in advance
- Other Renewable consists of unspecified RPS-eligible and carbon-free power, biomass and biogas
- Other Conventional consists of combustion turbines, internal combustion engines, and unspecified conventional power sources
- The faded blue area indicates the gap between planned energy purchases from the LSE plans and IEPR load. The gap is expected to be filled with short-term market purchases and does not imply any procurement or RA deficiencies.

Capacity Availability Analysis (MW)

- Staff aggregated the planned capacity purchases in the LSE baseline plans and compared the result to the existing (baseline) Net Qualifying Capacity (NQC) on the system
- Staff checked that planned capacity purchases do not exceed available NQC by resource class
- Staff checked if the existing resources in the aggregated LSE baseline plans are consistent with existing baseline units in SERVIM
- The following tables do NOT include the “new resources” selected by RESOLVE or the “new resources” indicated in LSE plans
- Staff is still validating whether capacity purchases reported by LSEs represent firm executed contracts only or whether estimates of future contracting outcomes were included
- The following slides do not constitute a Resource Adequacy (RA) assessment. Their purpose is to catalog the types and amounts of capacity LSEs are contracting for compared to the types and amounts of NQC available in the existing system.

Total existing available system Net Qualifying Capacity (NQC) MW for August, CAISO area (Table A)

General Type	Resource subcategory	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Thermal	CC	17,998	17,511	15,495	15,495	15,495	15,495	15,495	15,495	15,495	15,495	15,495	15,495
	CT	7,538	7,636	7,636	7,636	7,636	7,636	7,636	7,636	7,636	7,636	7,636	7,636
	Cogen	3,135	3,135	3,135	3,135	3,135	3,135	3,135	3,135	3,135	3,135	3,135	3,135
	ICE	211	211	211	211	211	211	211	211	211	211	211	211
	Steam	513	287	61	61	61	61	61	61	61	61	61	61
Nuclear	Nuclear	2,923	2,923	2,923	2,923	2,923	2,923	1,773	623	623	623	623	623
Solar	Solar PV	5,001	5,140	5,140	5,140	5,140	5,140	5,140	5,140	5,140	5,140	5,140	5,140
	Solar Thermal	512	512	512	512	512	512	512	512	512	512	512	512
Hydro	Hydro	5,570	5,570	5,570	5,570	5,570	5,570	5,570	5,570	5,570	5,570	5,570	5,570
	Pumped Storage Hydro	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832	1,832
Wind	Wind	2,485	2,485	2,485	2,485	2,485	2,485	2,485	2,485	2,485	2,485	2,406	2,406
Geothermal	Geothermal	1,728	1,728	1,728	1,728	1,728	1,728	1,728	1,728	1,728	1,728	1,728	1,728
Biomass	Biomass	464	464	464	464	464	464	464	464	464	464	464	464
Battery Storage	Battery Storage	391	433	475	1,115	1,115	1,115	1,115	1,327	1,327	1,327	1,327	1,327
Biogas	Biogas	212	212	212	212	212	212	212	212	212	212	212	212
TOTAL	TOTAL	50,513	50,079	47,879	48,519	48,519	48,519	47,369	46,431	46,431	46,431	46,352	46,352

Notes:

- This indicates the amount of total capacity that exists or is currently planned to be built (i.e. baseline), but does **NOT** include new resources selected by RESOLVE or indicated in the LSE “new resource” plans
- Yellow highlighting indicates a decrease in capacity (retirements) relative to the previous year, green highlighting indicates an increase. White means no change relative to the previous year.
- Capacity data is based on a data extract from SERVM. SERVM data is derived from the August 2017 CAISO Masterfile and TEPPC Common Case, with updates for announced retirements and repowers.
- Includes remote generators assumed to deliver into CAISO such as OOS Wind.
- Wind and solar are derated by their last adopted August Effective Load Carrying Capacity (ELCC) values to 26.5% and 41% of their nameplate, respectively.
- This table does not include the import capacity that is used in RA capacity counting.

Total planned purchases of Net Qualifying Capacity (NQC) MW (from existing available system NQC) for August, CAISO area, from LSE conforming plans (Table B)

General Type	Resource subcategory	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Thermal	CC	8,410	8,226	6,614	6,321	5,614	4,962	5,003	4,998	4,996	4,956	4,951	4,947
	CT	5,015	4,740	4,588	3,962	1,922	1,801	1,800	1,798	1,754	1,752	1,370	1,368
	Cogen	3,025	2,714	1,794	1,482	843	779	641	622	337	337	337	337
	ICE	163	163	163	163	163	163	163	163	163	163	163	163
	Steam	10	10	10	10	10	10	10	10	0	0	0	0
Nuclear	Nuclear	2,923	2,923	2,923	2,923	2,923	2,923	1,773	623	623	623	623	623
Solar	Solar PV	3,352	3,707	3,923	3,945	3,948	3,950	3,953	3,957	3,973	3,990	3,967	3,777
	Solar Thermal	617	617	617	617	617	617	617	617	617	617	617	617
Hydro	Hydro	3,346	3,120	2,990	2,990	2,990	2,990	2,990	2,990	2,989	2,989	2,989	2,989
	Pumped Storage Hydro	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
Wind	Wind	2,198	2,209	2,232	2,231	2,229	2,185	2,182	2,139	2,116	2,128	2,101	2,081
Geothermal	Geothermal	1,288	1,205	1,215	941	887	887	887	851	851	851	851	851
Biomass	Biomass	160	125	125	125	125	125	125	124	124	124	124	124
Battery Storage	Battery Storage	353	408	719	808	833	935	934	933	932	931	930	929
Biogas	Biogas	64	58	58	58	58	58	58	58	57	57	55	48
TOTAL	TOTAL	32,204	31,505	29,251	27,856	24,442	23,665	22,416	21,163	20,812	20,798	20,358	20,134

- Data represents planned capacity purchases in the baseline data only. Does not represent capacity from the new plans or RESOLVE selected resources, as these resources do not yet exist.
- Caveat: This data includes the Puente Power Project (262 MW) because SCE submitted it in the data template, though its status is uncertain. Puente's CEC permitting process has been suspended, but SCE has put out an RFP to address local capacity needs in Puente's sub-area (Moorpark).
- This table does not present an RA assessment and does not imply capacity surplus or deficit from that perspective.

Remaining existing CAISO system August NQC MW, that are not included in LSE conforming plans (Table A minus Table B)

General Type	Resource subcategory	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Available Capacity, 2030	% uncontracted, 2030
Thermal	CC	9,588	9,285	8,882	9,175	9,881	10,534	10,493	10,497	10,500	10,540	10,544	10,548	15,495	68%
	CT	2,523	2,896	3,048	3,673	5,713	5,835	5,836	5,838	5,882	5,884	6,266	6,267	7,636	82%
	Cogen	110	421	1,341	1,653	2,292	2,356	2,495	2,513	2,799	2,799	2,799	2,799	3,135	89%
	ICE	49	49	49	49	49	49	49	49	49	49	49	49	211	23%
	Steam	503	277	51	51	51	51	51	51	61	61	61	61	61	100%
Nuclear	Nuclear	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Solar	Solar PV	1,649	1,433	1,217	1,195	1,192	1,190	1,187	1,184	1,167	1,151	1,173	1,363	5,140	27%
	Solar Thermal	-105	-105	-105	-105	-105	-105	-105	-105	-105	-105	-105	-105	512	-21%
Hydro	Hydro	2,223	2,450	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,581	5,570	46%
	Pumped Storage Hydro	552	552	552	552	552	552	552	552	552	552	552	552	1,832	30%
Wind	Wind	288	276	253	254	256	301	303	346	370	357	305	326	2,406	14%
Geothermal	Geothermal	440	523	513	787	842	842	842	878	878	878	878	878	1,728	51%
Biomass	Biomass	304	339	339	339	339	339	339	340	340	340	340	340	464	73%
Battery Storage	Battery Storage	38	25	-243	307	282	180	181	394	395	396	397	398	1,327	30%
Biogas	Biogas	148	154	154	154	154	154	154	154	155	155	157	163	212	77%
TOTAL	TOTAL	18,310	18,575	18,631	20,664	24,078	24,858	24,957	25,271	25,623	25,637	25,996	26,220	45,729	57%

- This data is equal to the available system capacity (Slide 36) minus the planned capacity purchases (e.g. via capacity contracts) (Slide 37).
- For comparison purposes, the table shows available capacity in 2030 and the % uncontracted on the right.
- Negative numbers indicate possible over-reliance on these resources.
- This table does not present an RA assessment and does not imply capacity surplus or deficit from that perspective.

Percent of CAISO system August NQC MW included in LSE conforming plans, by year (Table B / Table A)

General Type	Resource subcategory	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Thermal	CC	47%	47%	43%	41%	36%	32%	32%	32%	32%	32%	32%	32%
	CT	67%	62%	60%	52%	25%	24%	24%	24%	23%	23%	18%	18%
	Cogen	96%	87%	57%	47%	27%	25%	20%	20%	11%	11%	11%	11%
	ICE	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%	77%
	Steam	2%	3%	16%	16%	16%	16%	16%	16%	0%	0%	0%	0%
Nuclear	Nuclear	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Solar	Solar PV	67%	72%	76%	77%	77%	77%	77%	77%	77%	78%	77%	73%
	Solar Thermal	121%	121%	121%	121%	121%	121%	121%	121%	121%	121%	121%	121%
Hydro	Hydro	60%	56%	54%	54%	54%	54%	54%	54%	54%	54%	54%	54%
	Pumped Storage Hydro	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Wind	Wind	88%	89%	90%	90%	90%	88%	88%	86%	85%	86%	87%	86%
Geothermal	Geothermal	75%	70%	70%	54%	51%	51%	51%	49%	49%	49%	49%	49%
Biomass	Biomass	34%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%
Battery Storage	Battery Storage	90%	94%	151%	72%	75%	84%	84%	70%	70%	70%	70%	70%
Biogas	Biogas	30%	27%	27%	27%	27%	27%	27%	27%	27%	27%	26%	23%

- Does **NOT** include new resources selected by RESOLVE or indicated in the LSE “new resource” plans
- Color scale shows the % of available system capacity that is being utilized
- Percentages equal (total LSE conforming plan August NQC MW divided by total CAISO system August NQC MW)*100%
 - Numbers less than 100% indicate that there exists uncontracted capacity not included in the LSE conforming plans
 - Green indicates a high amount of uncontracted capacity
 - Yellow and orange indicates less uncontracted capacity
 - Numbers greater than 100% (red) indicate possible over-reliance issues on that resource
- This table does not present an RA assessment and does not imply capacity surplus or deficit from that perspective.

Capacity Analysis Conclusions

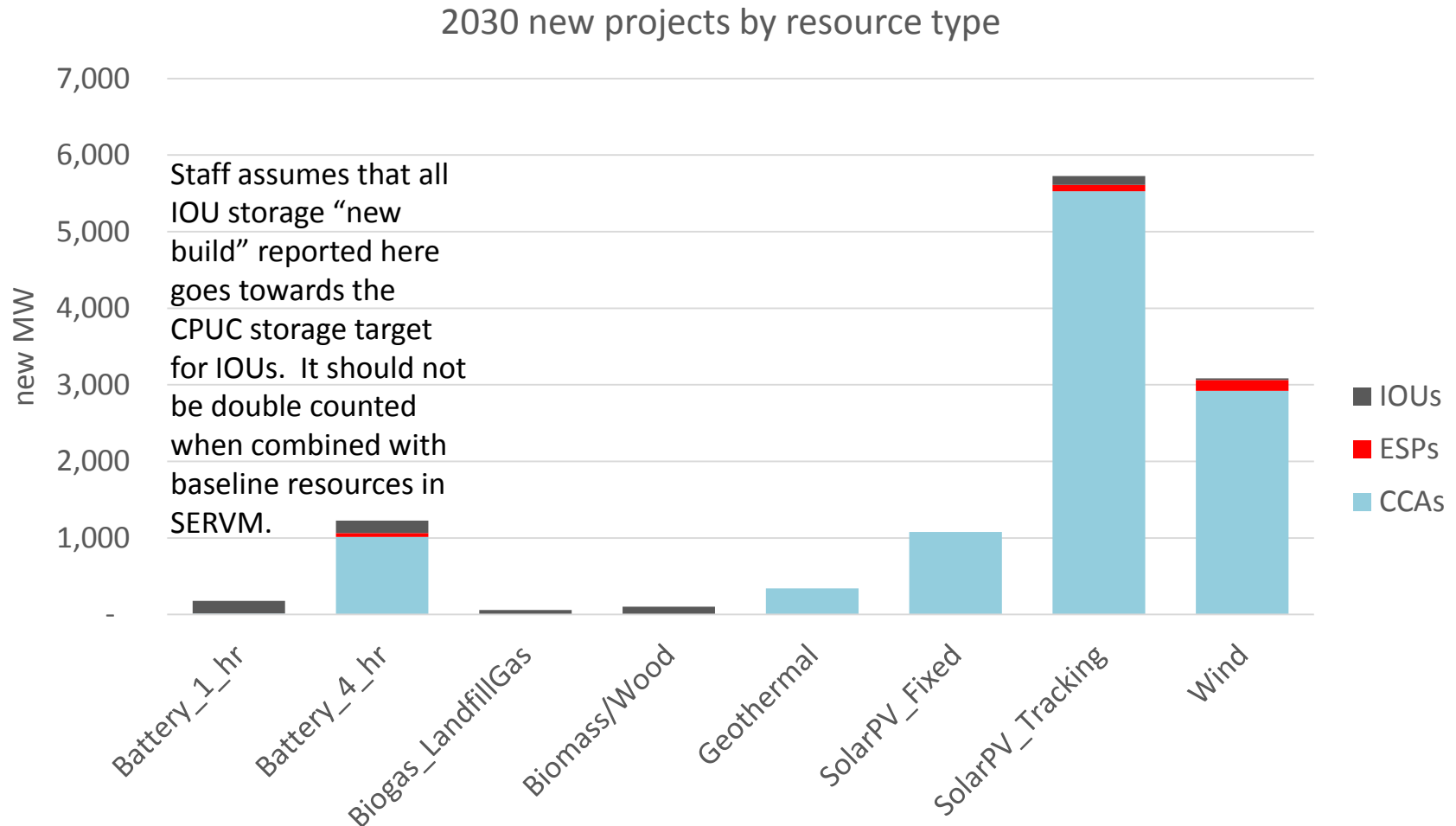
- Over-purchasing of capacity from existing resources is not generally anticipated to be a problem; there is leftover capacity (especially thermal) available to serve load.
 - A small discrepancy in solar thermal could be caused by differing NQC accounting
- A significant quantity of CC, CT, and cogeneration facilities are not included in LSE plans. Possible implications:
 - Many CC and CT plants are or may become merchant plants without contracts.
 - Older, less efficient plants may retire and may be excluded from baseline resources in the future.
- The battery oversubscription in 2021 may be caused by a one year difference in when planned battery capacity is expected to come online. Staff is investigating this issue.

Hydro availability analysis

- Staff appreciates party comments on the need to verify that LSE proposed purchases of in-state and out-of-state hydro are reasonable
- Staff is currently in the process of evaluating this question by analyzing the following:
 - Comparing historical in-state and out-of-state hydro procurement data, from both specified and unspecified sources, from the CEC to the LSE plans
 - Combining this data with S-1 and S-2 forms from retail energy providers that do not participate in the IRP process to get a California-wide view
 - Assessing the effects of climate change on hydro availability
 - Assessing dry-year risks
- Staff expects to present analysis results with the proposed Preferred System Plan

New Build Capacity Analysis (MW)

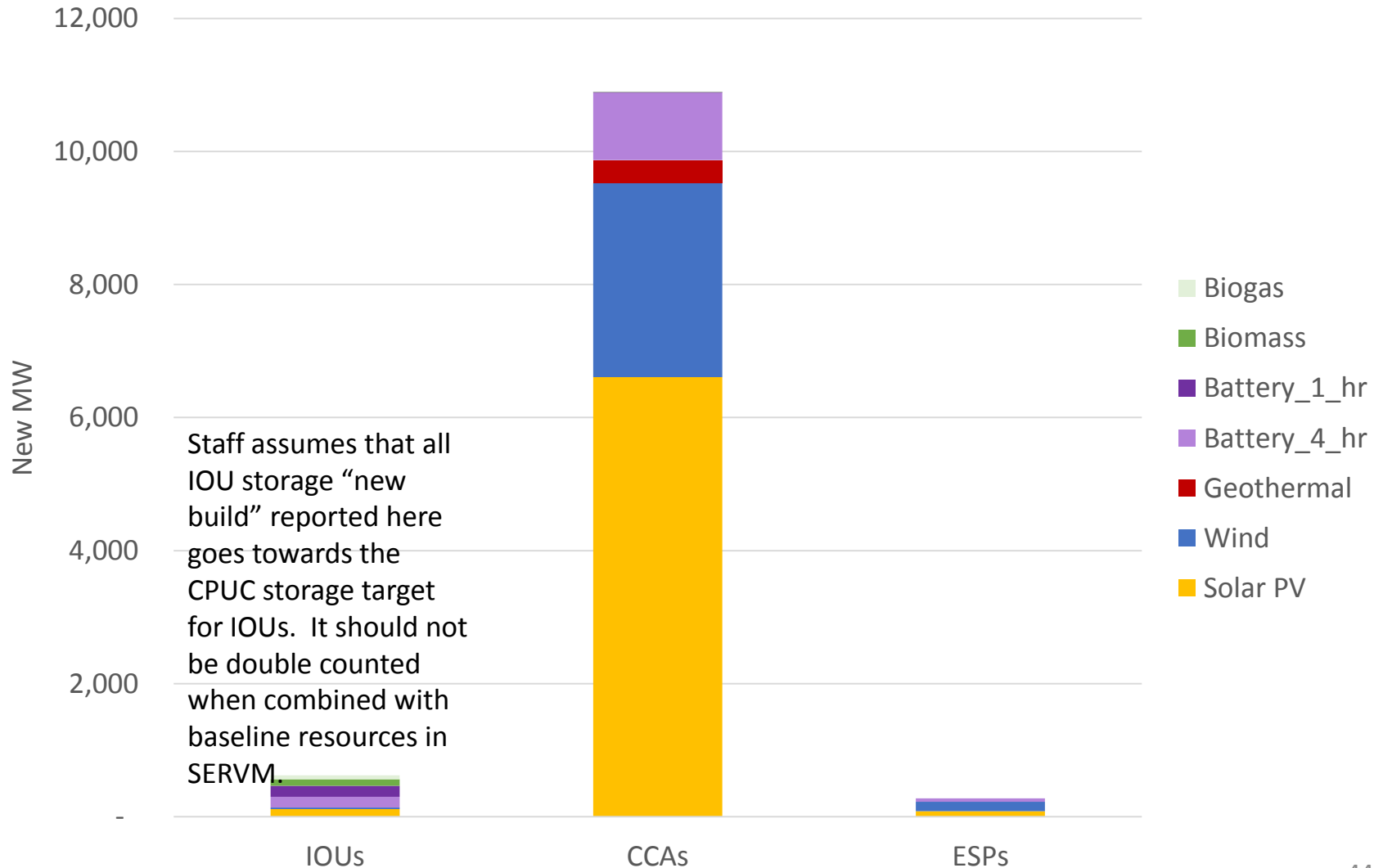
CCAs are proposing the bulk of new* resource buildout



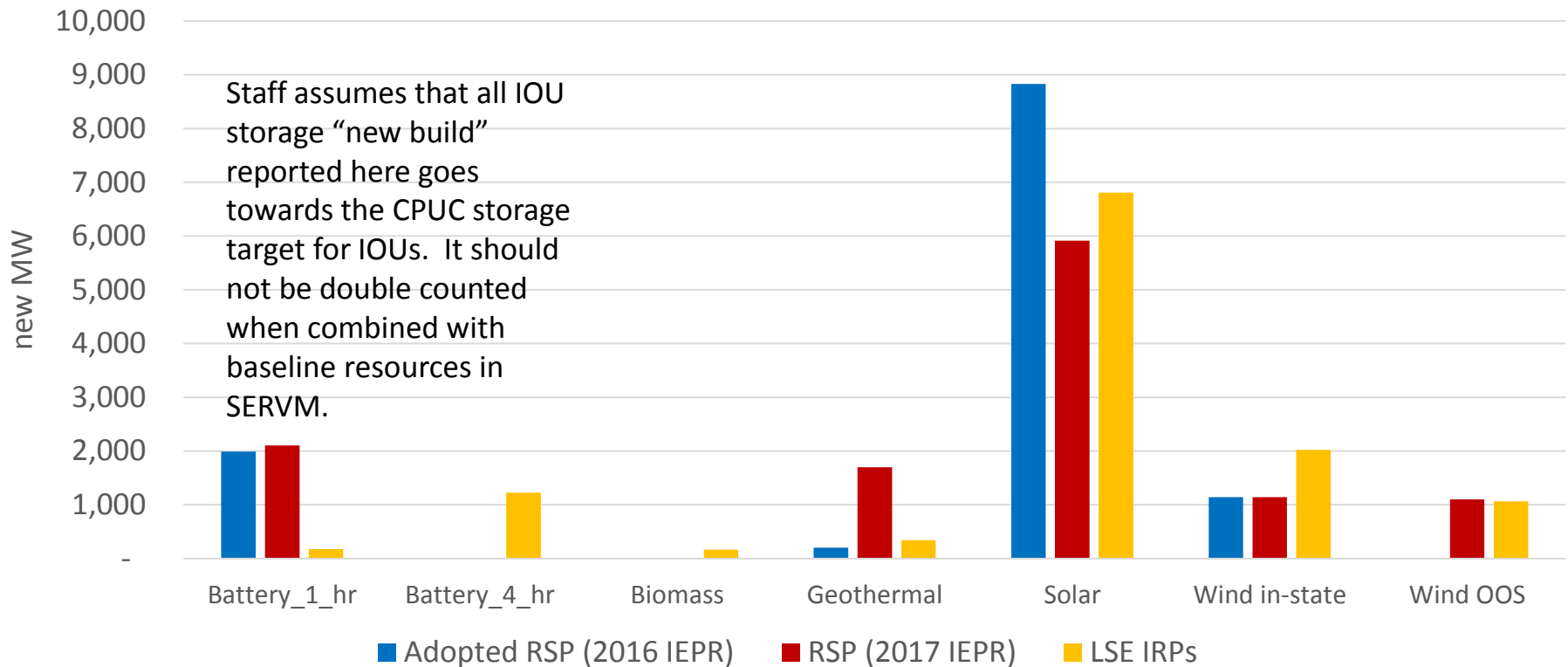
*New resources refers to resources that do not yet exist and are not yet contracted or planned as of 2018, but are included in IRP plans and could be built. The CPUC has not formally reviewed or approved the procurement of these resources.

The majority of proposed new capacity is solar, wind, and 4-hour batteries

2030 New Resource by type and LSE, MW



New Resources in LSE plans compared to 2030 Reference System Plan



- Compared to the Reference System Plan (RSP) calibrated with the 2017 IEPR, LSEs plan to purchase:
 - 1,900 **less** 1-hour battery MW
 - 1,200 **more** 4-hour battery MW
 - 1,400 **less** geothermal MW
 - 900 **more** solar MW
 - 900 **more** in-state wind MW

Note: The RSP updated to reflect the 2017 IEPR includes 1,500 MW **more** geothermal and 2,900 MW **less** solar PV than the adopted RSP based on the 2016 IEPR, which is provided for comparison purposes. The 2017 IEPR included more BTM PV than the 2016 IEPR, reducing the buildout of Utility-Scale PV in the RSP updated to reflect the 2017 IEPR. See the 3/29 MAG webinar materials located at <http://www.cpuc.ca.gov/General.aspx?id=6442451195> for further details.

Resource potential issues with LSE plans

- CPUC staff identified four regions where LSE proposed new wind build may exceed the resource potential assumed in RESOLVE
- RESOLVE resource potential limits are coarse with some uncertainty. Staff chose to firmly adhere to the limits in adjusting the aggregated plans to remove violations.

Region	RESOLVE resource potential (MW)	LSE proposed new wind build (MW)	Amount over potential (MW)
Northern California Wind	0*	438	438
Solano Wind	643	812	169
Southern California Desert Wind	0	120	120
Riverside East Palm Springs Wind	42	100	58

*As described in RESOLVE Inputs and Assumptions documentation, wind potential in Northern CA is assumed to be zero due to the “unproven nature of the resource and expected obstacles in resource permitting.” However, the raw source data in RESOLVE does indicate technical potential of about 5.1 GW.

Transmission availability issues with LSE plans

- CPUC staff identified five regions where LSE proposed new renewable build may exceed the available transmission capacity assumed in RESOLVE
- RESOLVE assumes limits for available Full Capacity Deliverability Status (FCDS) capacity or Energy Only (EO) capacity. The limits are coarse with some uncertainty. Staff chose to firmly adhere to the limits in adjusting the aggregated plans to remove violations.

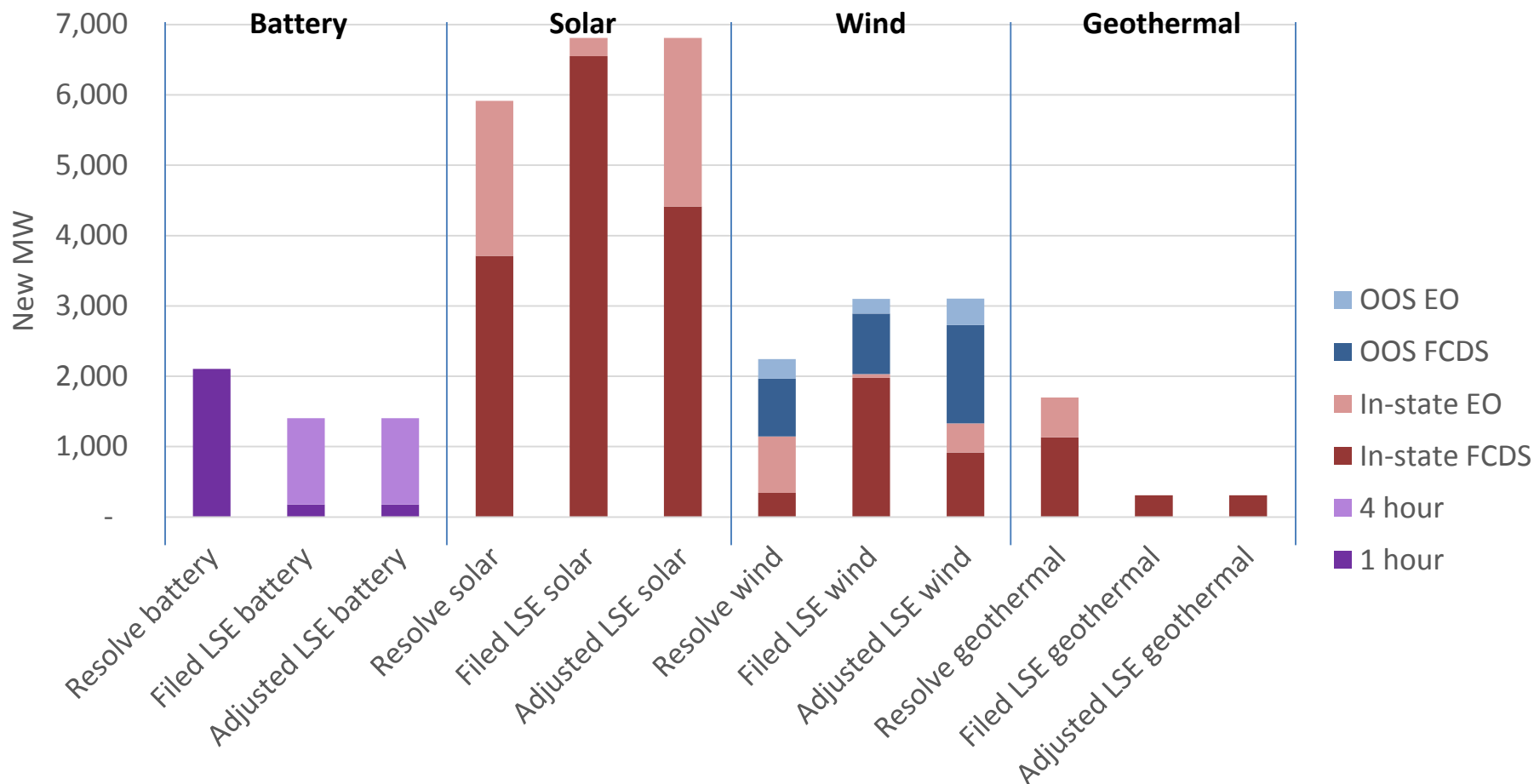
	RESOLVE available transmission capacity (MW)		LSE proposed new build (MW)		Amount over transmission capacity (MW)	
TX zone	FCDS	EO	FCDS	EO	FCDS	EO
Central Valley North Los Banos	697	0	1,386	19	689	19
Greater Carrizo	0	160	420	0	420	
Southern California Desert	0	0	2,637	34	2,637	34
Northern California	660	4,232	1,568	19	908	
Solano	0	700	967	30	967	

Guidelines for adjusting new build in LSE plans

- Staff manually adjusted location and deliverability status of proposed new build in the aggregate conforming portfolio of LSE plans
 1. Preserved location of resource where possible, either by converting to energy only or moving to an adjacent region
 - a. Solar was converted to energy only more than wind was due to the expected higher capacity value of wind
 - b. Use RESOLVE optimized build as a guide for moving resources to more optimal locations and whether energy only would be considered economic for that resource
 - c. Where reasonable, move fully deliverable resources to regions that had more available full deliverability transmission capacity
 2. Ensure RESOLVE assumed available transmission capacity is not exceeded
 3. Ensure RESOLVE assumed resource potential in a region is not exceeded
 - a. Exception for Northern California Wind (see note on slide 46). Staff assumed that LSEs proposing to procure this wind had better information about resource potential than RESOLVE assumed.
 4. LSE choices for OOS wind that may imply transmission upgrades (e.g. Wyoming or New Mexico) were retained. Staff assumed that LSEs intentionally selected this OOS wind as the best option for their needs. Staff will reach out to individual LSEs to verify the firmness of these choices.
 5. The above adjustment was only performed on the new build in 2030

Adjusted aggregation of 2030 LSE plans to match potential limits in RESOLVE

2030 new build comparison: RESOLVE, Filed LSE plans, Adjusted LSE plans



Resource types from Resolve, Filed LSE plans, and Adjusted LSE plans

- Total MW by resource type was preserved
- Relative mix of FCDS and EO capacity was adjusted
- OOS wind was increased to preserve LSEs' preference for wind in certain regions, including AZ, NM, and WY
- No adjustments were made to biomass/biogas so it is not shown to simplify the chart

Observations, Conclusions and Recommendations based on Aggregated LSE Plans

Observations and Conclusions

- **Many thermal resources in the Reference System Plan baseline are not reflected in aggregate LSE plans, especially after 2023**
 - LSEs generally do not have gas/RA contracts in place far into the future, so it is expected that many gas plants do not have contracts post 2023, whether or not those resources are at risk of retirement
- **The feasibility of some LSE plans is uncertain**
 - Certain LSEs requested that the CPUC not use their plans for planning.
 - Aggregate amounts of the LSEs' proposed new resources (wind, solar, batteries) may not be least-cost or least-environmental/land use impacting, depending on whether they actually exceed transmission constraints or resource potential.
- **Aggregate LSE plans alone do not include sufficient resources on an energy or capacity basis to conduct a reliability analysis**
 - This is due to two factors: Declining planned purchases over time to avoid over-hedging; and uncertainty regarding whether or how some baseline thermal resources will participate in the market

Proposed “Conforming Hybrid” Portfolio

- Based on these observations and conclusions, staff proposes to use the Reference System Portfolio updated with the 2017 IEPR already implemented in SERVM and tested via PCM analysis, with changes based on LSEs’ resource preferences from their plans
- Proposed steps to build a **“Conforming Hybrid”** Portfolio:
 1. Begin with As-found actual physical system from Attachment B of Ruling issued 9/24, i.e. the 2017 IEPR updated version of the RSP currently in SERVM
 2. Replace the “Selected Resources” (new build) in SERVM to reflect the LSE new build preferences as submitted in their IRP plans
 3. Where necessary, model the siting of new resources in different areas to correct for the transmission potential / resource potential issues previously described, such that triggering of new transmission build is minimized
 4. Remove thermal generation using the 40 year age threshold (and if still with a contract, extend life until end of contract, and if cogeneration with thermal host, keep online)
 5. Implement the other model input changes proposed on slide 20

Lessons Learned

- Simplify data template and reduce the number of inputs that LSEs must provide
- In aggregating the plans, staff developed metadata tables to help LSEs select from a finite list of pre-defined unit names and types
 - These can be provided in-template for the next cycle of IRP.
 - This has the dual benefit of reducing LSE data development work and minimizing the chance for inconsistencies between filings.
- Provide single identifier for resource from CAISO, TEPPC, or RPS
- Provide more explicit labeling of classes of resources (PCC, CAM, generic RA, etc)
- Staff can build in-template checks and pivot tables to catch errors and display up-front how staff plans to handle data

Questions for Discussion

- Do stakeholders agree with staff's proposed approach for aggregating and modeling the LSEs' Plans?
- Are there any other issues that should be considered when modeling the Conforming Hybrid portfolio?



Staff Recommendations for the CPUC Preferred System Plan and Portfolios for the CAISO Transmission Planning Process



October 31st, 2018

California Public Utilities Commission

Recommendations for the “Conforming Hybrid” Portfolio in IRP

- Staff proposes to develop and model the Conforming Hybrid portfolio using the approach described in previous sections
- Proposed use of the “Conforming Hybrid” portfolio:
 - To be incorporated into the **Preferred System Plan**, which would inform procurement and program activity in the CPUC IRP process
 - To serve as the **Reliability Base Case AND Policy-Driven Base Case** in the CAISO 2019-20 TPP

Purpose of the Preferred System Plan in IRP

- The IRP Decision (D.18-02-018) explains the purpose of the Preferred System Plan in IRP and its relationship to the CAISO Transmission Planning Process (TPP)
- In 2018 and subsequent even-numbered years:
 - LSEs will each file individual IRPs that propose how they will meet the GHG Planning Target and other policy goals.
 - CPUC staff will aggregate individual LSE plans into a single portfolio and conduct production cost modeling to ensure that the aggregated plans meet both reliability requirements and GHG emissions targets.
 - The CPUC will approve and/or modify individual LSE Plans and authorize any associated procurement activity, as necessary, to commence in the following 1-3 years.
 - **The CPUC will adopt the combined portfolio, called the “Preferred System Plan,” to inform procurement and program activity across multiple supply and demand resources, and for use in the CAISO TPP commencing in February of the following year**

CPUC IRP Coordination with CAISO TPP

- In accordance with a May 2010 MOU between CAISO and the CPUC, in coordination with the CEC, CPUC develops the renewable resource portfolios used by CAISO in its annual transmission planning process (TPP)
- The CPUC typically transmits to CAISO multiple distinct portfolios developed in its IRP process:
 - “Reliability Base Case” portfolio
 - “Policy-Driven Base Case” portfolio (may result in approval of new transmission)
 - and/or “Policy-Driven Sensitivity Case” (Category 2 – identified transmission solutions do not go to the ISO Board of Governors for approval)

Reliability Base Case Assessment

- The Reliability Base Case informs renewable generation inputs for CAISO's reliability assessments
- CAISO uses reliability assessments to...
 - Identify facilities with thermal overloads, voltage concerns, and stability concerns
 - Ensure that system performance can be met according to the requirements of the NERC transmission planning standards, the WECC transmission planning system performance criteria, and the CAISO planning standards over the ten (10) year planning horizon.
- In Feb. 2018 the CPUC transmitted the IRP “Default Scenario” (50% RPS by 2030) to the ISO for the 2018-19 TPP
- Staff proposes the “Conforming Hybrid” be used as the **Reliability Base Case** in the CAISO 2019-20 TPP

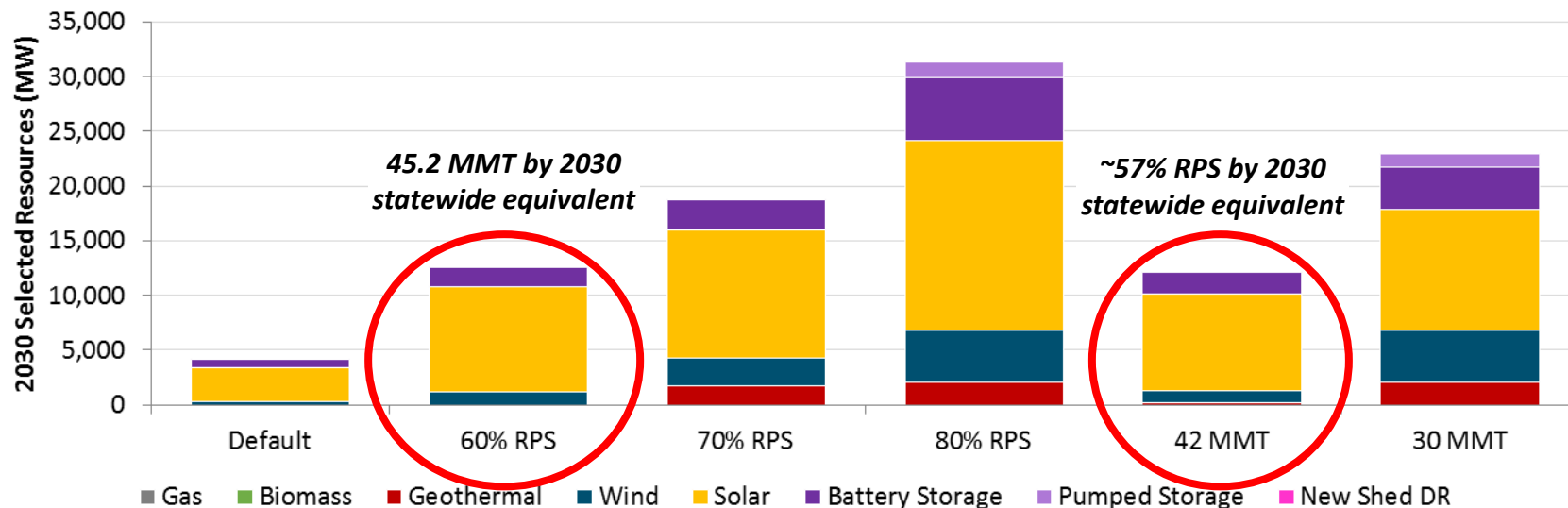
Policy-Driven Assessment

- The “policy-driven” category in TPP is used to plan for renewable grid integration issues and policy goals that may drive the need for new transmission
- The purpose of policy-driven transmission solutions is to meet state, municipal, county and federal policy requirements and directives
- The policy-driven portfolio is used to estimate deliverability (unlike the reliability base case)
- According to the Section 24 of the CAISO Tariff:
 - *“Policy driven transmission solutions will either be Category 1 of Category 2 transmission solutions. Category 1 transmission solutions are those which under the criteria of this section are found to be needed and are recommended for approval. Category 2 transmission solutions are those that could be needed to achieve state, municipal, county or federal policy requirements or directives but have not been found to be needed in the current planning cycle based on criteria set forth in this section.”*
- In Feb. 2018 the CPUC transmitted the 42 MMT Case (Reference System Portfolio) as a Policy-Driven Sensitivity in the 2018-19 TPP – identified transmission solutions were considered Category 2
- Staff proposes the “Conforming Hybrid” be used as the **Policy-Driven Base Case** in the CAISO 2019-20 TPP – identified transmission solutions will be considered Category 1

Proposed Policy-Driven Sensitivity Portfolio for CAISO TPP

- Staff also proposes to generate a “Policy-Driven Sensitivity” portfolio for the CAISO 2019-20 TPP
- This portfolio would be developed in RESOLVE and may not require production cost modeling in SERVIM because it will be used to identify only Category 2 transmission upgrades
- Two potential options:
 1. “SB 100” portfolio
 - Constraint: 60% RPS by 2030
 - Supply and demand-side assumptions: RESOLVE 2017 I&A but with the 2017 IEPR, updated with 5m ZEVs by 2030 goal, plus 40-year retirement of thermal resources
 2. “SB 100 plus” portfolio
 - Constraint: 32 MMT by 2030 in addition to 60% RPS by 2030
 - Supply and demand-side assumptions: Same as above

Rationale for “SB 100 plus”



- Staff studied **60% RPS by 2030** in IRP 2017, and the resulting buildout and GHG emissions were very similar to the adopted 42 MMT case (see above which used the 2016 IEPR demand forecast as input)
 - CAISO is evaluating the 42 MMT case as a Policy-Driven sensitivity in its 2018-19 TPP
- Updating the **60% RPS by 2030** case with the 5m ZEV goal is unlikely to materially change the results from the adopted 42 MMT case, which assumed 3.6m EVs by 2030
- 32 MMT by 2030** is consistent with the CEC Deep Decarbonization “High Electrification” scenario, which represents one of the lower cost, lower risk pathways to achieving the state’s 2045/2050 goals set forth in SB 100 and AB 32

Questions for Discussion

- Do stakeholders agree with staff's proposal for aggregating and evaluating the LSE portfolios as a "Conforming Hybrid" portfolio?
- Do stakeholders agree with staff's proposal to use this portfolio...
 - In the Preferred System Plan for IRP?
 - For the Reliability Base Case for CAISO TPP?
- Do stakeholders agree with staff's proposal to develop an "SB100" or "SB100 plus" scenario for CAISO's Policy-Driven sensitivity portfolio? Should any assumptions or constraints be modified?

Thank you for your participation

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Important links:

[IRP Events and Materials](#)

[Modeling Advisory Group](#)

[Modeling Projects](#)

[Modeling Data](#)

